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Zirconium-doped tungsten boride thin films deposited by magnetron sputtering combined with pulsed laser deposition

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Tungsten borides doped with transition metals (Ti, Cr, Mo, Ta etc) may have very wide range of applications in modern industry. Small addition of different dopants can result in increased thermal, oxidation, electrical properties when exhibiting high hardness.

In this work we present results of doping WB₂ coating with zirconium by using magnetron sputtering combined with pulsed laser deposition. Tungsten boride target (atomic ratio B/W = 2.5:1) was sputtered by magnetron powered with radio frequency electrical supply. Doping was carried out by evaporation of zirconium or zirconium diboride target by nanosecond laser pulse at 1064 nm wavelength. The amount of dopant in final coating was controlled by adjusting the laser fluence.

Surface morphology and chemical composition was analysed with scanning electron microscopy with EDS. Investigation of phase composition was performed by using X-ray Diffraction, hardness was measured by nanoindentation tester equipped with Berkovich indenter.

Observations have shown that doping with pure zirconium targets leads to creation of more droplets and higher amount of dopant when using the same laser fluence compared to zirconium diboride target. X-ray Diffraction has revealed that crystallinity of tungsten boride films changes with amount of zirconium. The hardness of presented coatings is high, up to 25GPa.

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